CLAIMS:

1. A method for characterising a molecule by mass spectrometry, which molecule comprises one or more free amino groups, which method comprises:

(a) reacting one or more free amino groups in the molecule with a mass tag reagent comprising a reactive functionality capable of reacting with an amino group, and a tertiary amino group linked to the reactive functionality; and

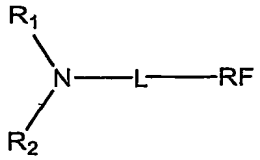
(b) characterising the molecule by mass spectrometry.

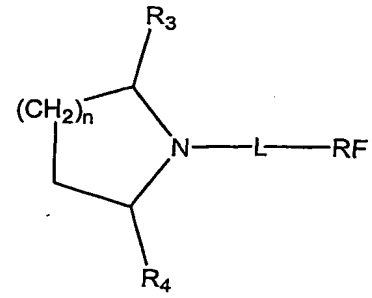
2. A method according to claim 1, wherein the reactive functionality, is selected from active esters of carbonic acids, alkenyl sulphones, haloalkanes, maleimides, isocyanates, isothiocyanates, ketones, aldehydes, sulphonyl-halides, carboxylic-halides, anhydride esters and alkenes.

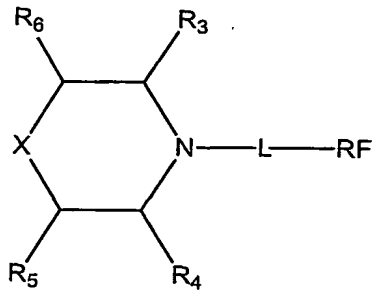
3. A method according to claim 1 or claim 2, wherein the tertiary amino group comprises a dialkyl substituted amino group, in which the alkyl groups may together with the nitrogen to which they are attached, form a cyclic group, and wherein the cyclic group may comprise an N, S and/or O atom.

4. A method according to any preceding claim, wherein the tertiary amino group is linked to the reactive functionality by a linker selected from an alkylene group and a phenylene group.

5. A method according to any preceding claim, wherein where the mass tag reagent is selected from a compound having one of the following formulae:






wherein $R^1$ and $R^2$ may be the same or different and are independently selected from alkyl groups and aralkyl groups;

$R^3$, $R^4$, $R^5$ and $R^6$ may be the same or different and are independently selected from hydrogen and alkyl groups;

n is an integer of 0, 1 or 2;

X is selected from N-alkyl, S and O;

the reactive functionality RF is selected from active esters of carbonic acids, alkenyl sulphones, haloalkanes, maleimides, isocyanates, isothiocyanates, ketones, aldehydes, sulphonyl-halides, carboxylic-halides, anhydride esters, alkenes, N-hydroxysuccinimide esters, hydroxybenzotriazole esters, hydroxyazabenzotriazole esters, nitrophenyl esters, trichlorophenyl esters and pentafluorophenyl esters; and

the linker L is selected from an alkylene group and a phenylene group.

6. A method according to claim 5, wherein $R^1$ and $R^2$ are independently selected from methyl, ethyl, propyl, iso-propyl, cyclohexyl, benzyl, and substituted benzyl groups.

7. A method according to claim 5 or claim 6, wherein $R^3$, $R^4$, $R^5$ and $R^6$ are independently selected from hydrogen and methyl, ethyl, propyl, and iso-propyl groups.

8. A method according to any of claims 5-7, wherein n is 2.

9. A method according to any of claims 5-8, wherein X is O;

10. A method according to any of claims 5-8, wherein when X is N-alkyl, alkyl is selected from a methyl, ethyl, propyl, iso-propyl or cyclohexyl group.

11. A method according to any of claims 5-10, wherein RF is selected from esters of carbonic acid, N-hydroxysuccinimide esters, hydroxybenzotriazole esters, hydroxyazabenzotriazole esters, nitrophenyl esters, trichlorophenyl esters and pentafluorophenyl esters.

12. A method according to any of claims 5-11, wherein L is selected from substituted or unsubstituted $-(CH_2)_n-$ in which n is an integer of from 1 to 5, and substituted or unsubstituted $-(C_6H_4)-$.

13. A method according to claim 12, wherein L is selected from $-CH_2-$ and $-(CH_2)_3-$.

14. A method according to any preceding claim, wherein the mass tag reagent is an ester of dimethylaminoglycine.

15. A method according to any preceding claim, wherein the mass tag reagent has a modified isotope distribution.

16. A method according to claim 15, wherein the isotope distribution of one or more of the following types of atoms is modified in the mass tag reagent: hydrogen, carbon, nitrogen, oxygen, sulphur and a halogen.

17. A method according to claim 16, wherein the isotope distribution is modified by replacing a portion of or all of $^{1}H$ by $^{2}H$, a portion of or all of $^{12}C$ by $^{13}C$, a portion of or all of $^{16}O$ by $^{18}O$ and/or a portion of or all of $^{14}N$ by $^{15}N$.

18. A method according to any preceding claim, wherein the molecule comprises a protein, a polypeptide, a peptide or an amino acid, or a derivative of the above.

19. A method according to claim 18, which method comprises:

(a) labelling free amino functionalities in the molecule with a mass tag reagent;

(b) cleaving the molecule with a sequence specific cleavage reagent, to produce cleavage products;

(c) labelling the free amino groups generated in the molecule by the cleavage reagent with a second mass tag reagent; and

(d) analysing the resulting cleavage products by mass spectrometry.

20. A method according to any preceding claim, wherein a plurality of molecules are characterised by mass spectrometry, wherein the characterisation includes determination of the quantity of at least one of the molecules.

21. A method according to claim 20, wherein each of the plurality of molecules is labelled with a differentially isotopically labelled mass tag reagent, such that the identity and quantity of each molecule may be determined by mass spectrometry.

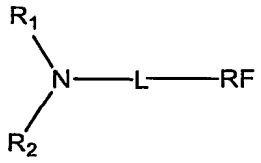
22. A method according to claim 20 or claim 21, wherein the mass tag reagent comprises a DMG mass tag reagent.

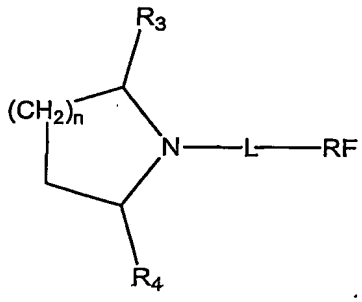
23. A mass tag reagent for labelling a molecule to be characterised by mass spectrometry, which mass tag reagent has the following formula:

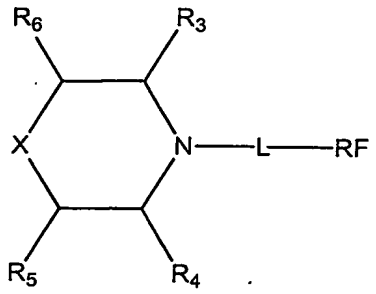
tertiary amino group-L-reactive functionality

wherein the reactive functionality, is selected from esters of carbonic acids, alkenyl sulphones, haloalkanes, maleimides, isocyanates, isothiocyanates, ketones, aldehydes, sulphonyl-halides, carboxylic-halides, anhydride esters, alkenes, N-hydroxysuccinimide esters, hydroxybenzotriazole esters, hydroxyazabenzotriazole esters, nitrophenyl esters, trichlorophenyl esters and pentafluorophenyl esters; and wherein the tertiary amino group comprises a dialkyl substituted amino group, in which the alkyl groups may together with the nitrogen to which they are attached, form a cyclic group, and wherein the cyclic group may comprise an N, S and/or O atom; and wherein L selected from an alkylene group and a phenylene group.

24. A mass tag reagent according to claim 23, having one of the following formulae:






wherein $R^1$ and $R^2$ may be the same or different and are independently selected from alkyl groups and aralkyl groups;

$R^3$, $R^4$, $R^5$ and $R^6$ may be the same or different and are independently selected from hydrogen and alkyl groups;

n is an integer of 0, 1 or 2;

X is selected from N-alkyl, S and O;

the reactive functionality RF is selected from active esters of carbonic acids, alkenyl sulphones, haloalkanes, maleimides, isocyanates, isothiocyanates, ketones, aldehydes, sulphonyl-halides, carboxylic-halides, anhydride esters, alkenes, N-hydroxysuccinimide esters, hydroxybenzotriazole esters, hydroxyazabenzotriazole esters, nitrophenyl esters, trichlorophenyl esters and pentafluorophenyl esters; and

the linker L is selected from an alkylene group and a phenylene group.

25. A mass tag reagent according to claim 23 or claim 24, wherein $R^1$ and $R^2$ are independently selected from methyl, ethyl, propyl, iso-propyl, cyclohexyl, benzyl, and substituted benzyl groups.

26. A mass tag reagent according to any of claims 23-25, wherein $R^3$, $R^4$, $R^5$ and $R^6$ are independently selected from hydrogen and methyl, ethyl, propyl, and iso-propyl groups.

27. A mass tag reagent according to any of claims 23-26, wherein n is 2.

28. A mass tag reagent according to any of claims 23-27, wherein X is O;

29. A mass tag reagent according to any of claims 23-27, wherein when X is N-alkyl, alkyl is selected from a methyl, ethyl, propyl, iso-propyl or cyclohexyl group.

30. A mass tag reagent according to any of claims 23-29, wherein RF is selected from esters of carbonic acid, N-hydroxysuccinimide esters, hydroxybenzotriazole esters, hydroxyazabenzotriazole esters, nitrophenyl esters, trichlorophenyl esters and pentafluorophenyl esters.

31. A mass tag reagent according to any of claims 23-30, wherein L is selected from substituted or unsubstituted $-(CH_2)_n-$ in which n is an integer of from 1 to 5, and substituted or unsubstituted $-(C_6H_4)-$.

32. A mass tag reagent according to any of claims 23-31, wherein L is selected from $-CH_2-$ and $-(CH_2)_3-$.

33. A mass tag reagent according to any of claims 23-32, wherein the mass tag reagent has a modified isotope distribution.

34. A mass tag reagent according to any of claims 23-33, wherein the isotope distribution of one or more of the following types of atoms is modified in the mass tag reagent: hydrogen, carbon, nitrogen, oxygen, sulphur and a halogen.

35. A mass tag according to claim 34, wherein the isotope distribution is modified by replacing a portion of or all of $^{1}H$ by $^{2}H$, a portion of or all of $^{12}C$ by $^{13}C$, a portion of or all of $^{16}O$ by $^{18}O$ and/or a portion of or all of $^{14}N$ by $^{15}N$.

36. An array of mass tags for labelling one or more molecules to be characterised by mass spectrometry, which array comprises two or more mass tags as defined in any of claims 23-35.

37. An array of mass tags according to claim 36, wherein every mass tag in the array has the same chemical structure, and each mass tag in the array is an isotopomer of the other mass tags in the array such that each mass tag in the array has a different mass.

38. A kit for purification of labelled analyte molecules, which kit comprises one or more mass tags as defined in any of claims 23-37, and a cation exchange resin.

39. A kit according to claim 38, which kit further comprises one or more components selected from a reaction buffer for the coupling of the tag to analyte molecules, a buffer for washing the cation exchange resin, and a buffer for elution of the labelled peptides from the cation exchange resin.